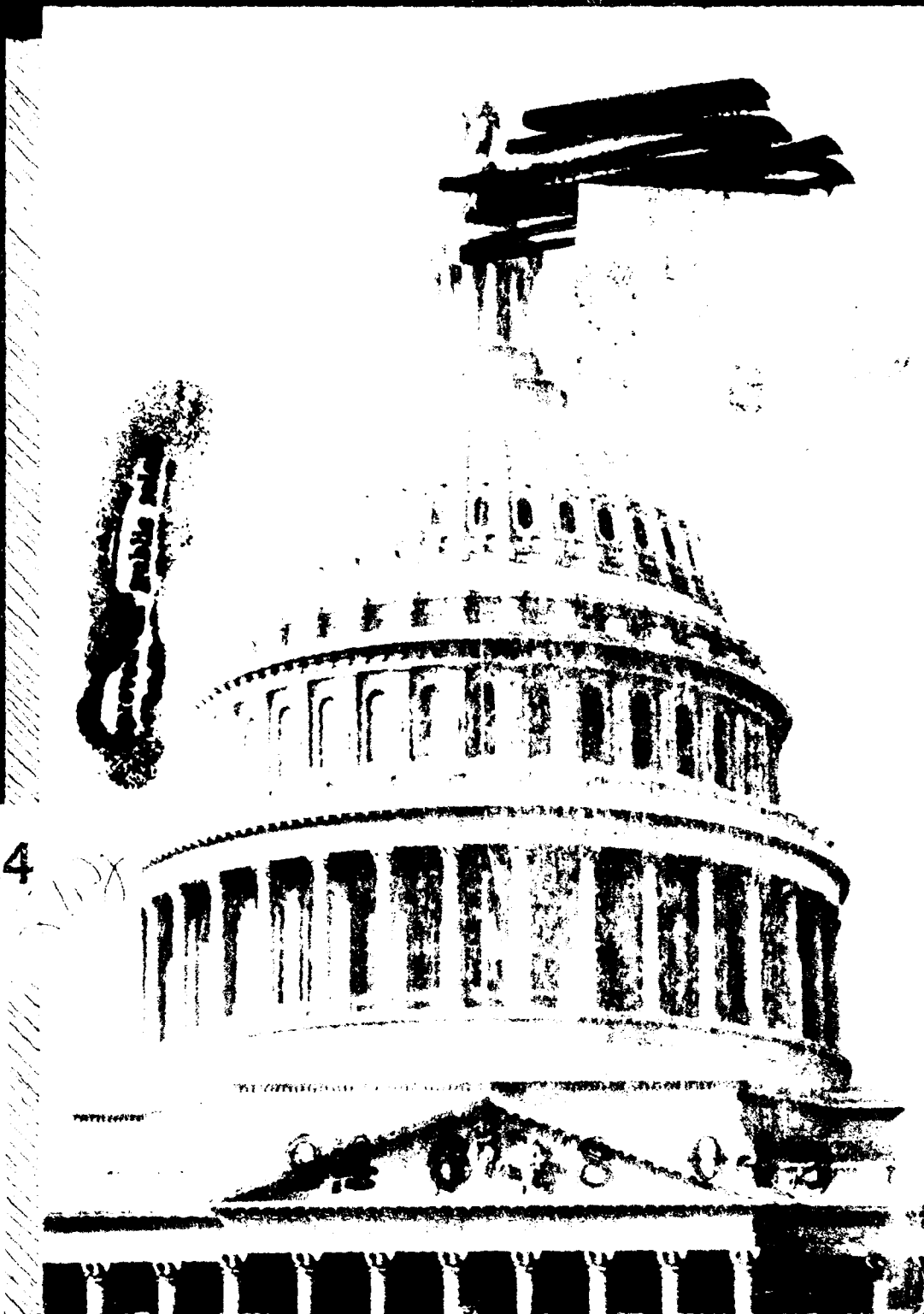
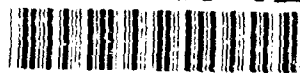


Federal basis for Weights and Measures

A historical review
of Federal legislative
effort, statutes, and
administrative action
in the field of weights
and measures in the
United States.

94-17424



Accession For	
NTIS	CRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

THE
federal basis for
Weights and Measures

A historical review of Federal legislative effort, statutes, and administrative action in the field of weights and measures in the United States.

Ralph W. Smith



DTIC QUALITY INSPECTED &

National Bureau of Standards Circular 593

Issued June 5, 1958

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Price 30 cents

Preface

There is a continuing demand upon the National Bureau of Standards for information on various phases of weights and measures administration. The historical background of the regulatory activities of today, and in particular the area of Federal legislation in this field, is frequently explored by weights and measures officials, by writers on topics of business economics, by teachers and students of civics, and by researchers in the practical functioning of government, and it is partly to answer inquiries from such persons that this Circular is issued. However, a lasting purpose is believed to be served by presenting for historical record a single publication combining information previously available only from scattered sources, and comprising, for the period 1776-1956, a connected story of Federal weights and measures legislation and congressional efforts toward that end, with appropriate references to certain closely related circumstances and actions.

A. V. ASTIN, *Director.*

III

Contents

	Page
Preface.....	III
Introduction.....	1
The Hassler Era, 1776-1836.....	1
Résumé of the Hassler Era.....	10
The Mendenhall Era, 1836-1896.....	10
Résumé of the Mendenhall Era.....	17
The Modern Era, 1896-1956.....	19
Résumé of the Modern Era.....	22
References.....	23

The Federal Basis for Weights and Measures

A Historical Review of Federal Legislative Effort, Statutes, and Administrative Action in the Field of Weights and Measures in the United States

Ralph W. Smith

A review is presented, for the period 1776-1956, very largely in chronological form, of congressional efforts and accomplishments in the general weights and measures area, with particular emphasis on units and standards.

Certain important and closely related administrative actions initiated by Hassler and Mendenhall in the nineteenth century are cited. Current Federal statutes having weights and measures significance are discussed briefly. In its entirety the Circular presents a connected and reasonably comprehensive story of the Federal contribution to the legislative basis for weights and measures administration in the United States.

Introduction

It is the purpose of this Circular to present a connected account of the Federal legislative background and the present Federal statutory provisions in the field of weights and measures units, standards, and administration[1]¹. Reference is made to two administrative decisions of great importance in this relation, both by officials of the Treasury Department; these decisions dealt with the adoption in 1832 of basic units of length, mass, and capacity, upon the recommendation of F. R. Hassler, Superintendent of the Coast Survey, and the recognition in 1893 of the International Prototype Meter and Kilogram as fundamental standards for the United States, upon the recommendation of T. C. Mendenhall, Superintendent of Standard Weights and Measures.

Basically chronological in treatment, the text of the Circular includes such related and explanatory comment as should serve to give the reader a clear understanding of what has taken place, without burdening him with extended discussion or speculation.

The period specifically covered is 1776-1956, a space of 180 years. This period can appropriately be broken down into three 60-year divisions ending, successively, in 1836, 1896, and 1956. The first of these divisions may, for convenience, be referred to as the "Hassler Era," because in it Hassler rose to prominence, made far-reaching weights and measures decisions, and carried out the provisions of the Joint Resolution of June 14, 1836, which was the legislative culmination of the era, directing that standards of weight and measure be furnished to the States. Again for convenience, the second 60-year division may be termed the "Mendenhall Era," because it was near the close of this period that the so-called "Mendenhall Order" was promulgated, recognizing standards of the metric system as fundamental for the United States. The final 60-year division may appropriately be designated the "Modern Era."

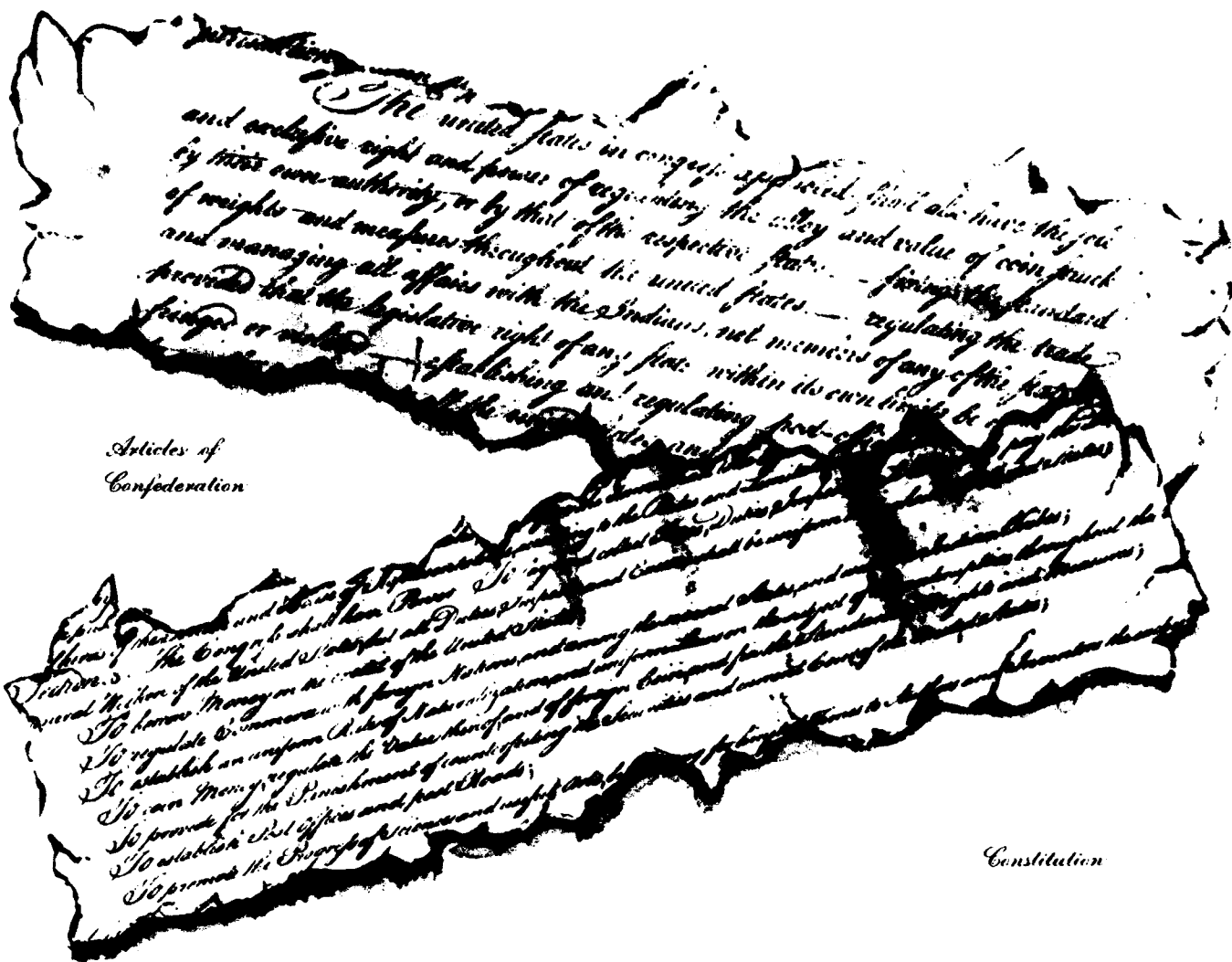
The treatment herein will be separated into three parts, according to the three eras defined above.

The Hassler Era, 1776-1836

The history of the United States as a nation may be considered to have begun with the Declaration of Independence in 1776, and its legislative history with the ratification by the Colonies, in 1781, of The Articles of Confederation. At its very beginning, then, the Federal Government recognized the

problem of uniform weights and measures standards, for in their grant of powers to the Continental Congress, the Articles of Confederation specified (in article 9, paragraph 4) one of these powers to be "fixing the standard of weights and measures throughout the united states." Later, when the

¹ Figures in brackets indicate the literature references at the end of this Circular.



That portion of paragraph 4 of article 9 of the Articles of Confederation, granting to the Continental Congress the "sole and exclusive right and power of * * * fixing the standard of weights and measures throughout the united states * * *" and of section 8 of article 1 of the Constitution of the United States, granting to the Congress the power "To regulate Commerce * * * among the several States, * * * To * * * fix the Standard of Weights and Measures * * *".

(Photographs by the Library of Congress)

Constitution of the United States became effective in 1789, the Congress of the United States was given powers in the weights and measures area by two paragraphs of section 8 of article I of the Constitution, the pertinent language being as follows:

The Congress shall have Power * * * To regulate Commerce * * * among the several States, * * * To * * * fix the Standard of Weights and Measures;

The importance attached to the regulation of weights and measures by the framers of these two important charters is indicated by the fact that in the Articles of Confederation the fixing of the standard of weights and measures and the regulation of the coinage were treated in the same paragraph, and that in the Constitution of the United States the

association of these two powers is even closer, both matters being treated in a single sentence.²

Before proceeding to a résumé of the troubled course of weights and measures legislative action during the fifty years succeeding the adoption of the Constitution, a brief discussion is in order on an important distinction between the two constitutional grants of power to the Congress in the field of weights and measures that are included in the quotation, *supra*, from section 8.

The power to "fix the standard of weights and measures" grants a specific, broad, and unrestricted

² The full text of this sentence, which is clause 5 of section 8 of article I of the Constitution, is "To coin Money, regulate the Value thereof, and of foreign Coin, and fix the Standard of Weights and Measures."

authority in a field fundamental to the exchange of commodities, and thus basic to the conduct of business and commerce. The words in which this delegation of power is phrased are known and referred to as the weights and measures clause of the Constitution. When the Congress acts under this authority, it legislates for the country as a whole, without regard to State boundaries.

The words "to regulate commerce * * * among the several States" are known as the interstate commerce clause of the Constitution. Here is found an authority that is broad and reasonably specific, but that is restricted in that it does not embrace all commerce but is limited to commerce *among the several States*. Thus the Congress acting under authority of the interstate commerce clause legislates only with respect to interstate commerce. Avoiding the niceties of distinction embodied in numerous judicial decisions, interstate commerce may be broadly defined as commerce that crosses one or more State lines; and this is to be distinguished from intrastate commerce, which is confined within the borders of a single State.

The majority of the Federal weights and measures laws are interstate, rather than intrastate, in their application. In order to subject intrastate transactions to the same regulation as is imposed by the Federal statutes upon interstate transactions, the common expedient is to cause reenactment as State statutes of the appropriate provisions of the Federal acts.

To provide a proper perspective for a consideration of the story of Federal legislation, it should first be made clear that during colonial times the several Colonies acted independently in weights and measures matters. Colonists brought standards of various kinds with them or imported standards from the countries from which they had emigrated. Colonial laws were enacted adopting standards, defining units, and in a number of instances providing for officials to test commercial weighing and measuring devices. In the majority of cases these laws sought to adopt, for use in the Colonies, the standards recognized in England. Typical of the language of such laws are expressions such as "according to the approved Winchester measures allowed in England in the exchequer," "according to the standard of Her Majesty's exchequer, in her realm of England," and "according to the standard of London."

The serious approach to weights and measures legislation even in the very early colonial days is

indicated by these introductory phrases of a law enacted by one of the Colonies in 1703 [2]:

Whereas nothing is more agreeable to common justice and equity, nor for the good and benefit of any people or Government, who live in community and friendship together, than that they have one equal and just weight and balance, one true and perfect standard and assize of measure among them; for want whereof experience shows that many frauds and deceits happen, which usually fall heavy upon the meanest and most indigent sort of people, who are least able to bear the same, and may be accounted little better than oppression; for remedy of which evil,

*Be it enacted * * **

The practical problem of maintaining that which had been adopted is sharply reflected in "An Act relating to the standard of English weights and measures", passed by a Colony in 1715, which began with these words [3]:

Whereas the standards of English weights and measures are very much impaired in several of the counties of this province, and in some wholly lost or unfit for use:

The problem was not easily or quickly solved, for more than one hundred years later, well after this Colony had become a State, an official of that State wrote [4]:

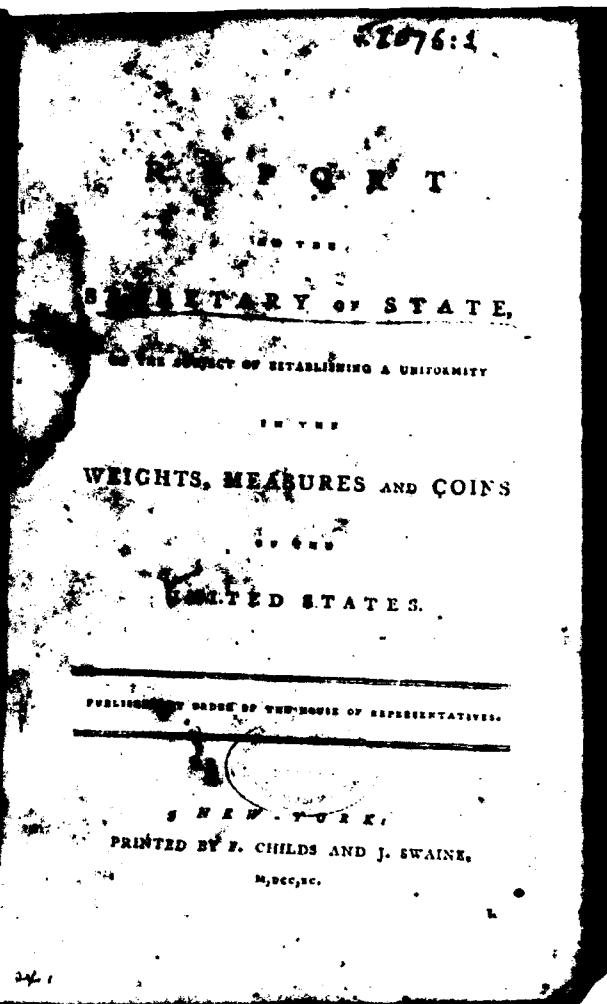
* * * It is believed that the English standard of measures has not in practice been adhered to, as it is recollected that some years ago the half-bushel which was used for measuring grain at E _____ was larger than the one in use at B _____, and that the same measure in B _____ was somewhat larger than the old standard kept in the different counties. It is believed, also, that a similar difference, in a small degree, exists between the fifty-six and other weights regulated in B _____ and those adjusted by the standard-keepers in the counties. * * *

When the first Congress of the United States undertook its labors it must be assumed that widespread divergence existed in the values of the standards accepted as official in the several States. From this situation it would necessarily follow that there was a lack of uniformity in the commercial equipment in use and in the weighings and measurements made with such equipment, among the States and probably also among sections of individual States. Such conditions obviously were increasingly troublesome as commercial intercourse increased among the States.

In his first message to the Congress, in January 1790, President George Washington said: "Uniformity in the currency, weights, and measures of the United States, is an object of great importance, and will, I am persuaded, be duly attended to" [5]. Again there is found the close coupling of the cur-

Title page of the first extensive report to the Congress on the subject of uniformity in the weights and measures of the United States, made in 1790 by Thomas Jefferson, Secretary of State.

(Reproduced from the Collections of the Library of Congress)



rency and weights and measures, as matters of like importance. For purposes of this discussion the general matter of the coinage and currency may now be dismissed with the comment that the Congress was not slow in taking action upon it, in contrast with its handling of weights and measures matters.

As a direct result of Washington's recommendations to the Congress, the House of Representatives requested the Secretary of State, Thomas Jefferson, to prepare and report to the House a plan for establishing uniformity in the weights and measures of the United States. It so happened that at this very time weights and measures studies were being conducted by both England and France. Jefferson's rather extensive report, made to the House in July 1790, was colored to some extent by material published by the British and French, and proposed two plans for consideration. The first plan was based "on the supposition that the present Weights and Measures are to be retained, but to be rendered

uniform and invariable, by bringing them to the same invariable standard". It was proposed that the inch be related to the length of a rod vibrating in seconds at 45° latitude; a gallon of 270 cubic inches and a bushel of 8 gallons, or 2160 cubic inches, were proposed; and it was proposed that it "be established that an ounce is of the weight of a cube of rain-water, of one tenth of a foot, or rather, that it is the thousandth part of the weight of a cubic foot of rain-water, weighed in the standard temperature; that the series of weights of the United States shall consist of pounds, ounces, penny-weights, and grains; whereof 24 grains shall be one penny-weight; 18 penny-weight one ounce; 16 ounces one pound" [6]. The second plan proposed "reducing every branch to the same decimal ratio already established in their coins, and thus bringing the calculation of the principal affairs of life within the arithmetic of every man who can multiply and divide plain numbers * * *" [7].

Action had not been taken on the Jefferson proposals when President Washington addressed his second message to the Congress in December 1790, in which he said [8]:

The establishment of the militia, of a mint, of standards of weights and measures, of the post office and post roads, are subjects which (I presume) you will resume of course, and which are abundantly urged by their own importance.

Within a matter of days the Jefferson report was communicated by the House to the Senate, where it was referred to a select committee for study and report. Two months later the committee reported to the Senate as follows [9]:

As a proposition has been made to the National Assembly of France for obtaining a standard of measure which shall be invariable, and communicable to all nations, and at all times; as a similar proposition has been submitted to the British Parliament, in their last session; as the avowed object of these is, to introduce a uniformity in the measures and weights of the commercial nations; as a coincidence of regulation, by the Government of the United States, on so interesting a subject, would be desirable, your committee are of the opinion, that it would not be eligible, at present, to introduce any alteration in the measures and weights which are now used in the United States.

This report was accepted by the Senate, and this action effectively put a stop to consideration of the subject at the time.

About six months later (October 1791) President Washington addressed his third message to the Congress; uniformity of weights and measures was one of the subjects of which "particular mention" was made, in these words [10]:

A uniformity in the weights and measures of the country is among the important objects submitted to you by the Constitution and, if it can be derived from a standard at once invariable and universal, must be no less honorable to the public councils, than conducive to the public convenience.

A select Senate committee was promptly appointed to consider the subject of weights and measures, and some five months later (April 1792) this committee recommended the adoption of a decimal system of weights and measures, this being in substance the second of the plans proposed earlier by Thomas Jefferson. The report was received, but consideration was postponed to the succeeding session of the Congress. During December 1792 the subject of weights and measures was before the Senate on four separate occasions, but no action was taken.

Some two years later there was a resurgence of weights and measures interest in the Congress, inspired by President Washington when, in January

1795, he apprised that body of a communication from the French Minister relative to adoption by the United States of a system of weights and measures conformable to the metric system adopted not long before by France. A select committee of the House was appointed before the end of the year to consider the French suggestion and to reconsider the Jefferson report of 1790; this committee reported (April 1796) in favor of retaining the existing foot and avoirdupois-pound units and of relating all measures of surface, capacity, and weight to measures of length. It was proposed that skilled persons be employed to ascertain the length of a seconds pendulum and to make other determinations preliminary to the establishment of an integrated system of weights and measures. A bill to this effect, and appropriating funds for the purpose, passed the House (May 1796) and was sent to the Senate, but the Senate did not enact it.

This point in the chronology of Federal legislative effort appears to mark the end of the first phase of such effort, dominated by the Jefferson report. The fact that the Congress did not enact legislation, notwithstanding numerous urgent requests from the States for action to relieve the existing confusion in commercial transactions, can probably be attributed primarily to the difficulty of resolving the technical perplexities inherent in the problem.

In 1799, during the second session of the Fifth Congress, there was enacted the first Federal weights and measures law. This Act of March 2, 1799, dealt not with the establishment of uniform standards but with the testing for accuracy and the correction of the weights, measures, and other instruments used in ascertaining duties on imports. The law directed the surveyor of each port of the United States to make such tests periodically with standards to be provided for that purpose by each collector. Because no standards had ever been adopted, the law was ineffective; it was not until more than thirty years later, following adoption of certain standards by the Treasury Department, that this law became operative.³

The period between 1799 and 1828 was marked, as had been the two preceding decades, by requests for the adoption of standards, appointment of select committees of the Congress to consider standardization, the preparation and presentation of numerous committee reports, and extended discussions; but no

³ This law is still in effect. Although the offices of surveyors of customs except at the Port of New York have been abolished, it appears that the Secretary of the Treasury has the power to authorize the performance by other officers of the duties here prescribed.

legislation resulted. This period was highlighted, however, by the classic report of John Quincy Adams, prepared at the request of the Senate.

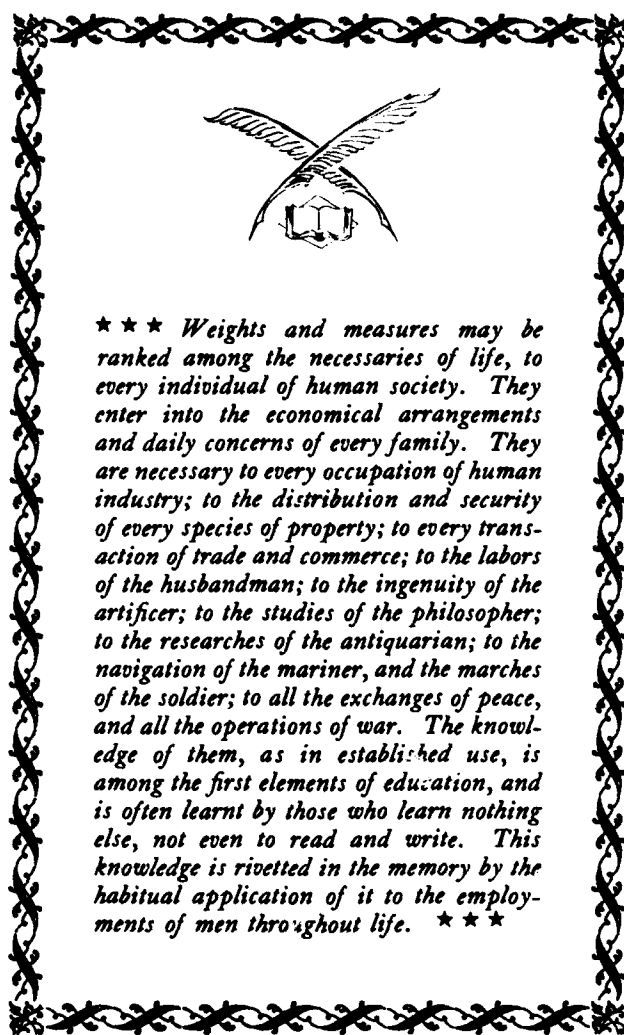
It was in December 1816 that President Madison, in his message to the Congress, reminded that body that no legislation had as yet been enacted to effectuate uniformity in weights and measures standards and suggested the adoption of a decimal system as proposed earlier in the Jefferson report. A select committee of the Senate was appointed to consider the President's suggestions. In March 1817 the Senate adopted a resolution reported by this committee, under the terms of which the weights and measures question was referred to the Secretary of State, then John Quincy Adams. He was instructed to prepare and report to the Senate "a statement relative to the regulations and standards for weights and measures in the several States, and relative to the proceedings in foreign countries for establishing

uniformity in weights and measures, together with such propositions relative thereto as may be proper to be adopted in the United States" [11]. A similar resolution was adopted by the House on December 14, 1819. Just a few days short of four years after adoption of the Senate resolution, under date of February 22, 1821, Adams transmitted his report to the Senate, where it was ordered that 600 copies of the report be printed [12]. A copy of the report was also transmitted by Adams to the House; there it was ordered that the report be laid upon the table.

The Adams report on weights and measures was a scholarly and elaborate document. As printed in 1821 the main body of the report covered 131 pages, and there was an Appendix covering an additional 109 pages. Much historical information was embodied in the report, including an "inquiry into the theory of weights and measures, as resulting from the natural



Title page of the classical "Report upon Weights and Measures" by John Quincy Adams, transmitted to the Senate on February 22, 1821, and Adams' evaluation of "weights and measures," from pages 119 to 120 of that report.



(Reproduced from the Collections of the Library of Congress)

history of man." Particular and detailed attention was given to the development of weights and measures in England and France. The English and French systems were analyzed and compared. The weights and measures legislation of each of the then States was summarized. The advisability of the adoption by the United States of the new French (metric) system was discussed at some length. Finally the question of what steps it would be appropriate for the Congress to take was thoroughly explored, and a two-part plan was proposed [13]:

1. To fix the standard, with the partial uniformity of which it is susceptible, for the present, excluding all innovation.
2. To consult with foreign nations, for the future and ultimate establishment of universal and permanent uniformity.

There was no immediate reaction on the part of the Congress to the Adams report.

It is appropriate here to revert to the years preceding the filing of the Adams report in order to record a circumstance of some interest and importance. Being plagued by the commercial confusion and controversies resulting from nonuniformity of standards and wanting to do all that could be done at the State level to relieve the situation, State after State enacted legislation fixing standards and setting up systems of control for commercial devices. Uniformity among the States could not, of course, be achieved by this pattern of action by individual States, for in most cases what the States were doing was legalizing the standards that were then in use. For example, an act passed in one State in 1800 declared the standard of the corn measures of the State to be certain brass measures already the property of the State, and defined one of these as a "half-bushel measure, containing one thousand and ninety-nine cubic inches, very near"; this law went on to say, among other things, that a certain brass vessel, ordered by the legislature to be provided, "of the capacity of two hundred and twenty-four cubic inches", should, when procured, be the standard of the wine gallon in the State [14].

Two years before the Adams report was transmitted to the Congress, a committee of the House, to which the perennial question of weights and measures standardization had been referred, made its report—on January 25, 1819. This report proposed "that standards conformed to those in most common use among us should be accurately made, and carefully preserved at the seat of Government; that correct models should be placed in the different districts of the country; and that the proportions

and relations between these should be ascertained." It was proposed specifically that the President be authorized to appoint a commission to direct the making of the experiments and precise determinations contemplated and the construction of the national standards, and of "models" thereof (yard, bushel, wine gallon, and avoirdupois pound) for distribution "among the States" [15]. It was ordered by the House that this report be laid on the table.

About one year later (December 1819) there was introduced into the House a resolution to appoint a committee to explore the question of weights and measures. In consideration, however, of the expected receipt of the report requested from the Secretary of State in March 1817, this resolution was withdrawn by its introducer.

There was, as has been stated, no immediate congressional reaction to the Adams report on weights and measures, submitted in February 1821. However, in December of that year the Adams report was referred to a select committee of the House, and that committee made its report on March 11, 1822. The committee recognized the thorough and comprehensive character of Adams' report and deemed it necessary only to submit for action by the Congress two resolutions considered appropriate to "render uniform and stable the weights and measures which we at present possess." One of these resolutions would have requested the procurement, by the President of the United States, of precise copies of the English yard of 1601, avoirdupois pound, Winchester bushel, and wine gallon; the other would have requested the construction of "models" of standards of length, mass, and capacity, "for distribution among the States and Territories, and for the purpose of verifying the weights and measures used therein" [16]. No action was taken on these resolutions.

In May 1826 a resolution was introduced into the House by its Committee on Weights and Measures, calling for certain experiments to determine the length of a seconds pendulum at New York and at Washington and to establish "the proportions between the length of such pendulums and the standard yard recently adopted [1760] by the British Government". Lengthy debate ensued during which it was reported that great loss of revenue was resulting from differences in the standards used in customhouses throughout the country; by the experiments proposed it was expected to establish a basis for an integrated system of weights and measures standards corresponding to those adopted by England. The records

do not show that this resolution was adopted or that the experiments called for therein were ever conducted.

Albert Gallatin, Minister of the United States in London, had procured, in 1827, a brass troy pound that had been compared with the imperial troy pound of Great Britain by one Captain Kater, and that was stated by him to be an exact copy thereof. This troy pound was delivered under Mr. Gallatin's seal to the Philadelphia Mint, where it was kept until, on October 12, 1827, President Adams verified the seal, and the casket containing the weight was opened and the weight given over to the custody of the mint. The President reported these facts to the Congress; as a result, on May 19, 1828, there was enacted the first effective weights and measures law of this country, this being the "Act to continue the mint at the City of Philadelphia, and for other purposes", section 2 of which read in part [17]:

That, for the purpose of securing a due conformity in weight of the coins of the United States * * * the brass troy pound weight procured by the minister of the United States at London, in the year one thousand eight hundred and twenty-seven, for the use of the mint, and now in the custody of the director thereof, shall be the standard troy pound of the mint of the United States, conformably to which the coinage thereof shall be regulated.⁴

Actually, this troy pound became for a time the fundamental mass standard of the United States; when the Treasury Department adopted certain units preparatory to constructing weights and measures standards for the customs service (as discussed below), one of these units, the avoirdupois pound, was derived from the troy pound of the mint.

On May 29, 1830, the Senate, having been reminded by one of its members of the report, two years before, to the effect that differences in the standards in use at various customhouses were causing loss of revenue, adopted the following resolution [18]:

Resolved, That the Secretary of the Treasury be directed to cause a comparison to be made of the standards of weights and measures now used at the principal customhouses in the United States, and report to the Senate at the next session of Congress.

⁴ In the first revision of the statutes of the United States, this language was changed to read: "For the purpose of securing a due conformity in weight of the coins of the United States * * * the brass troy-pound weight procured by the minister of the United States at London, in the year eighteen hundred and twenty-seven, for the use of the Mint and now in the custody of the Mint at Philadelphia, shall be the standard troy pound of the Mint of the United States, conformably to which the coinage thereof shall be regulated." (Revised Statutes 1873-74, Sec. 3548.) The inclusion of the specific reference to the "Mint at Philadelphia" was dictated, no doubt, by the fact that whereas in 1828 there was only one United States mint, additional mints were authorized by the acts of March 3, 1835 (Charlotte, N. C., Dahlonega, Ga., and New Orleans, La.), July 3, 1852 (San Francisco, Calif.), April 21, 1862 (Denver, Colo.), and March 3, 1863 (Carson City, Nev.).

The execution of this directive was assigned by the Secretary of the Treasury to Ferdinand Rudolph Hassler, a man of great ability and energy; during the succeeding decade Hassler played a most important part in fixing the standards of weight and measure of the United States.

The investigation of the standards in use at the customhouses disclosed that serious differences existed in the values of the standards used at various ports, but it appeared that average values for the standards were in fairly good agreement with the values of corresponding British standards at the time of the American Revolution. In submitting to the Senate (in 1832) Mr. Hassler's report on this investigation, Louis McLane, the then Secretary of the Treasury, referred to the discrepancies found as "a serious evil", and then went on to make this significant statement [19]:

It is believed, however, that this department has full authority to correct the evil, by causing uniform and accurate weights and measures, and authentic standards, to be supplied to all custom houses. With this view, proceedings were instituted by my predecessor [S. D. Ingham], with the President's approbation, and are now in progress, for effecting that object, by fabricating at the United States Arsenal in this city, under the immediate personal superintendence of Mr. Hassler, the necessary standards, as well as weights and measures, with all the exactness that the present advanced state of science and the arts will afford.

As a prerequisite to the construction of the weights and measures for the customs service, certain fundamental units were adopted by the Treasury Department, upon Hassler's recommendation, as follows:

1. The yard of 36 inches.
2. The avoirdupois pound of 7000 grains, being $\frac{7000}{5760}$ pounds troy.
3. The gallon of 231 cubic inches.
4. The bushel of 2150.42 cubic inches.

The following interesting account dealing with these units is extracted from History of the Standard Weights and Measures of the United States, by Louis A. Fischer [20].

The standard yard adopted was the 36 inches comprised between the twenty-seventh and the sixty-third inches of a certain 82-inch brass bar, prepared for the Coast Survey by Troughton, of London. This bar had been brought to the United States by Hassler in 1813 [The year 1813 is incorrect. The correct date is 1815.], and the 36-inch space referred to was supposed to be identical with the English standard at 62° F., though it had never been directly compared with that standard.

It is evident from the reports of Mr. Hassler that he regarded the English yard as the real standard of length of the United States and the Troughton scale merely as a copy whose length should be corrected if it was sub-

sequently found to differ from the English yard; and this view was taken by those who subsequently had charge of our standards, as will be shown later on.

The avoirdupois pound adopted by Mr. Hassler as the standard for the Treasury Department was derived from the troy pound of the mint according to the equivalent, 1 avoirdupois pound equals $\frac{7000}{5760}$ pounds troy. This was the accepted relation in this country as well as in England; hence both the troy and avoirdupois pounds adopted were in practical accord with the similar standards of Great Britain.

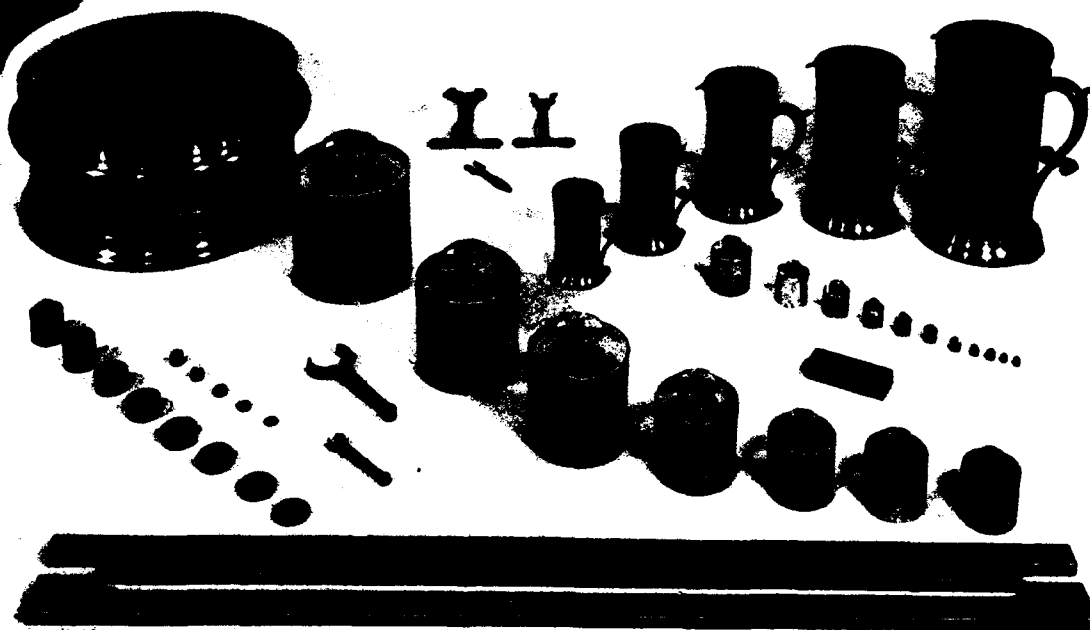
The units of capacity, namely, the wine gallon of 231 cubic inches and the Winchester bushel of 2,150.42, were adopted, because, as intimated, they represented more closely than any other English standards the average of the capacity measures in use in the United States at the date of Mr. Hassler's investigation. The wine gallon was introduced as a wine measure into England in 1707, during the reign of Queen Anne, but it was abolished in 1824, when the new imperial gallon, containing 10 pounds of water, was made the standard. This last statement applies also to the bushel of 2,150.42 cubic inches. This bushel is the earliest English capacity measure of which

we have any record, a copy of it made by order of Henry VII being still in existence. But this bushel had also been abolished in England, it having been superseded by the bushel of 8 imperial gallons. Therefore neither the gallon nor the bushel adopted by the United States Treasury Department was in accord with the legal capacity standards of England, but they were smaller by about 17 percent and 3 percent, respectively, and these differences exist at the present time. Not only did they differ from the new standards in Great Britain, but they also differed from the discarded English standards from which they were derived for the reason that Mr. Hassler selected the temperature of the maximum density of water, namely, 39.2° F., as the temperature at which the United States measures were standard, whereas their English prototypes were standard at 62° F. [Footnote by Fischer: According to the determination made by Mr. Hassler on the expansion of water, 39.83° F. was the temperature of maximum density.]

Such, then, were the fundamental standards adopted upon the recommendation of Mr. Hassler by the United States Treasury Department, and to which the weights and measures for the customs service were made to conform. The construction of the weights and measures for this purpose was pushed with almost feverish haste * * *

Ferdinand Rudolph Hassler (1770-1843)

The first Superintendent of the Office of Weights and Measures in the Treasury Department, and as such, responsible for the construction and distribution to the States of standards of length, mass, and capacity of the customary system (below) under authority of the Joint Resolution of Congress of June 14, 1836, and of balances under authority of the act of July 7, 1838.



In the foreground are the end-standard yard measure and the graduated matrix into which it fits. At left center are troy weights from 1 pound to fractions of the ounce, and special weight lifters. Avoirdupois weights range from 50 pounds to fractions of the ounce, with smaller fractional weights in the small box at right center. Centered at the back are three more weight lifters. At upper left is the half-bushel measure and at upper right are liquid capacity measures from $\frac{1}{2}$ pint to 1 gallon, each with its own ground-glass cover plate.

In October, 1834, the British imperial yard and troy pound made in 1758, of which the Troughton scale and the mint pound were supposed to be exact copies, were destroyed by the burning of the Houses of Parliament. When the new imperial standards to replace them were completed in 1855 two copies of the yard and one copy of the avoirdupois pound were presented to the United States, arriving in this country in 1856. One of these bars, namely, bronze yard No. 11, was very soon after compared with the Troughton scale, the result showing that the accepted 36 inches of the Troughton scale was 0.00087 inch longer than the British imperial yard. The second bar received from England was subsequently compared with the Troughton scale and fully corroborated the result obtained from the comparison with bronze No. 11. The new yards, and especially bronze No. 11, were far superior to the Troughton scale as standards of length, and consequently they were accepted by the Office of Weights and Measures [see footnote 12, p. 15] as the standards of the United States, and all comparisons were afterwards referred to the imperial yard through these two standards. They were twice taken to England and recompared with the imperial yard, once in 1876 and again in 1888.

The avoirdupois pound presented with the two yards was also compared with the United States avoirdupois pound derived from the mint pound, the result showing a very satisfactory agreement. The advent of the new pound did not, therefore, disturb the position of the troy pound of the mint or of the avoirdupois pound derived from the mint pound.

As the construction of the standards for the customhouses proceeded, reports on the progress of the work were made, from time to time, to the Congress. Again there was interest in and out of the Congress in the establishment of standards. On June 14, 1836, the Congress adopted a Joint Resolution reading as follows [21]:

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he hereby is, directed

to cause a complete set of all weights and measures adopted as standards and now either made or in progress of manufacture for the use of the several custom-houses and for other purposes, to be delivered to the governor of each State in the Union, or such person as he may appoint, for the use of the States, respectively, to the end that a uniform standard of weights and measures may be established throughout the United States.

Résumé of the Hassler Era, 1776-1836.—This early period in the life of the Nation was marked by repeated Presidential reminders addressed to the Congress to take action with respect to weights and measures standards in order that uniformity throughout the country might be established. Two important State Papers were produced, the Jefferson Report in 1790, and the Adams Report in 1821. In 1830 the Senate directed the Secretary of the Treasury to cause an examination to be made of the weights and measures used at the customhouses, and F. R. Hassler was assigned to conduct this survey. Upon Hassler's recommendation, fundamental units of length, mass (weight), and capacity were adopted by the Treasury Department in 1832, and new standards, based on these units, were constructed for the customhouses. By Joint Resolution of June 14, 1836, the Congress directed the Secretary of the Treasury to furnish to each State a complete set of the weights and measures adopted as standards for the customhouses, and Hassler was assigned to carry out this program.

Thus the Hassler Era produced a sequence of events that culminated in the first definite congressional action directed to uniform weights and measures standards throughout the country—the Joint Resolution of June 14, 1836—and the initiation, under Hassler's direction, of a program to that end.

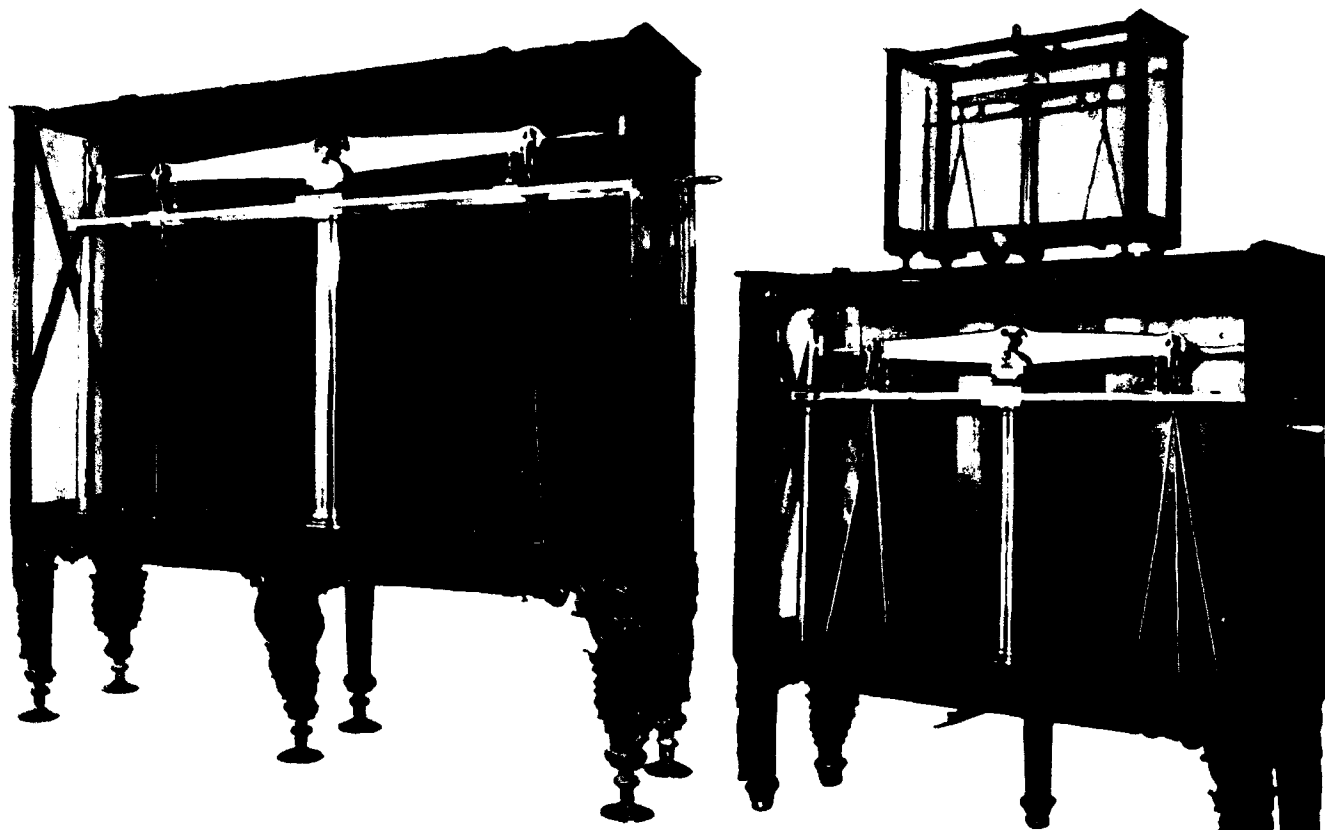
The Mendenhall Era, 1836-1896

It may well be said that the adoption of the Joint Resolution of June 14, 1836, marked the end of the six-decade era of initial national uncertainty regarding standards of weight and measure, and the beginning of a period of like duration, characterized by a series of important actions and occurrences culminating in the "Mendenhall Order" of 1893, under which the meter and kilogram of the metric system became recognized as the "fundamental" standards of length and mass of the United States. The chronology is resumed.

In an obvious effort to promote actual use by the

States of the mass standards to be furnished them by the Federal Government under the terms of the Joint Resolution of 1836, a further gift, this time of balances, was authorized in 1838. This grant was made in one of several amendments made to an appropriation act approved July 7, 1838 [22], this amendment reading as follows:

That the Secretary of the Treasury cause to be made, under the superintendence of Mr. Hassler, one standard balance for each State, and that when completed he cause them to be delivered to the respective Governors for the use of the respective States.



Three testing balances furnished by the Federal Government to the States under the act of July 7, 1838

The 50-pound balance is shown at the left. At the right are shown the small-size balance (capacity 1 pound) and the medium-size balance (capacity about 10 pounds). Note similarity of design of all three balances. (The fronts of the balance cases were removed for photographing.)

It is interesting that under this authority balances in three capacities instead of one were built for the States, a large (capacity 50 pounds), a medium (capacity about 10 pounds), and a small (capacity 1 pound).⁵ It is not clear from the records now

available that each State received three balances, one of each capacity, but it is known that this was the case in some States, and it is presumed that the normal distribution was on the basis of three balances per State.

⁵ An interesting commentary on this departure from the specific terms of the statute is found in House Document No. 159, 28th Congress, 2d Session; this document comprises a report dated February 26, 1845, by A. D. Bache, Hassler's successor as Superintendent of Weights and Measures, on the progress made in the construction of standard weights, measures, and balances during the year 1844. Appended to Bache's report, as Appendix A thereto, is a special report, dated January 4, 1844, made to the Secretary of the Treasury by Edward Hassler, a son of F. R. Hassler, who had served for some years as his father's assistant in the construction of weights, measures, and balances. In this special report Edward Hassler quotes that paragraph of the 1838 Act authorizing the furnishing to each State of "one standard balance," and then goes on to say:

"The spirit of the above law is, that the States be furnished with means by which they will be enabled to determine any question that may arise, with such a degree of nicety as to be as valuable for all practical purposes as if absolutely exact.

"This object cannot be secured by any single balance; consequently arises the necessity of seeking the best means of accomplishing the desired object. Experience has proved that it cannot be secured with sufficient accuracy by less than three balances.

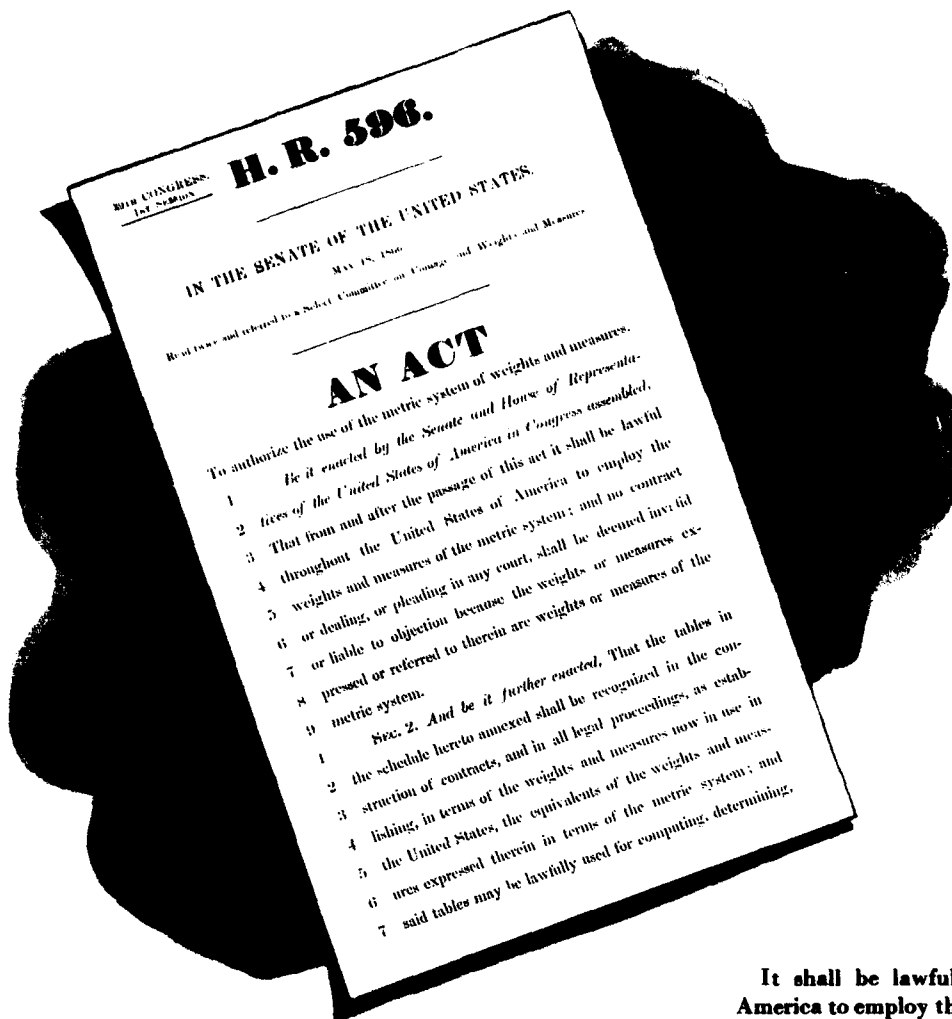
"Consequently, I considered myself justified in carrying out the spirit, and securing to the country the important and so-much-needed object of the law."

It was for the purpose of carrying out the congressional directives of 1836 and 1838 that the Office of Weights and Measures was established, under the direction of the Superintendent of the Coast Survey in the Treasury Department.

To complete without interruption the account of the gifts of weights and measures by the Federal Government to the States, two additional Joint Resolutions of Congress are here reported.

The Joint Resolution of July 27, 1866, reads as follows [23]:

That the Secretary of the Treasury be, and he is hereby, authorized and directed to furnish to each State, to be delivered to the governor thereof, one set of standard weights and measures of the metric system for the use of the States, respectively.



First page of H. R. 596, May 18, 1866, on its way to becoming the act of July 28, 1866, which legalized throughout the United States the employment of weights and measures of the metric system.

(Reproduced from the Collections of the Library of Congress)

The Joint Resolution of March 3, 1881, reads, in pertinent part, as follows [24]:

That the Secretary of the Treasury be, and he is hereby, directed to cause a complete set of all the weights and measures adopted as standards to be delivered to the governor of each State in the Union, for the use of agricultural colleges in the States, respectively, which have received a grant of lands from the United States, * * * *Provided*, That the cost of each set shall not exceed two hundred dollars, * * *

Directly related to the Joint Resolution of July 27, 1866, is the law of July 28, 1866, which made legal throughout the United States the employment of weights and measures of the metric system. As enacted, the text of this law ⁶ was as follows:

⁶ Compare U. S. Code, 1952 Ed., Title 15, Ch. 6, Sections 204 and 205. The texts of these two sections conform, respectively, to the texts of the two paragraphs of the original act except that in the second of these paragraphs the word "hereto" is omitted, and there is substituted for the word "now", in the phrase "now in use in the United States", the words "on June 22, 1874". The words "on June 22, 1874" first appear in the U. S. Code, 1934 Ed., and have been retained in succeeding editions of the Code. The only significance of this date appears to be that June 22, 1874, was the closing date for the 1874 "Revised Statutes of the United States"; why this date was chosen for insertion in the paragraph in question in 1934 is not now apparent, but in any event its inclusion does not affect the force and effect of the paragraph at this time.

It shall be lawful throughout the United States of America to employ the weights and measures of the metric system; and no contract or dealing, or pleading in any court, shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.

The tables in the schedule hereto annexed shall be recognized in the construction of contracts and in all legal proceedings as establishing, in terms of the weights and measures now in use in the United States, the equivalents of the weights and measures expressed therein in terms of the metric system; and said tables may be lawfully used for computing, determining, and expressing in customary weights and measures the weights and measures of the metric system.

The "schedule" mentioned in the act comprises four tables, listing "metric denominations and values" and the corresponding "equivalents in denominations in use" for measures of length (8 denominations), capacity (7 denominations), and surface (3 denominations), and for weights (10 denominations).⁷

Mention may also be made of an act of July 18, 1866, in which, "for the purpose of estimating the duties on importations of grain", it was prescribed

⁷ This schedule will be found, in full, following Section 205 in U. S. Code, 1952 Ed., Title 15, Ch. 6, and in NBS Circular 501, "Federal and State Weights and Measures Laws", page 11.

that the number of bushels be ascertained by weighing instead of by measuring, and bushel weights were established for wheat, corn, rye, barley, oats, peas, and buckwheat.

The Joint Resolutions of 1836, 1866, and 1881, and the laws of 1838 and 1866 comprise the total of congressional directives in the field of standard systems or units of weights and measures. There are no broad and specific congressional requirements imposing uniformity among the States in the matter of standards. However, the immediate result of the early distribution of standards to the States was, in almost all cases, the adoption as State standards of the standards so received from the Federal Government. Thus, by indirection, was uniformity brought about. It may be noted in passing that two provisions common to many current State weights and measures laws operate now to establish a firm basis for national uniformity of standards. The first of these provisions is to the effect that weights and measures in conformity with those furnished to the State by the Federal Government, supplied by the State and certified by the National Bureau of Standards, shall also be State standards. The second provision is to the effect that the State standards shall be submitted once every ten years to the National Bureau of Standards for recertification.

Information on the construction and distribution of the standards by the Office of Weights and Measures is found in a series of reports transmitted to the Congress by the Secretary of the Treasury. A particularly comprehensive and interesting report is the "Report of the Secretary of the Treasury on the Construction and Distribution of Weights and Measures", 34th Congress, 3d Session, Executive Document No. 27. This was published in Washington in 1857 by "A. O. P. Nicholson, Printer," in a volume comprising 218 pages.

In this Executive Document No. 27 it is stated that the "full set of weights and measures" then being supplied to States comprised the following items:

- 1 box containing two weights, 25 and 50 pounds avoirdupois.
- 1 box containing eight weights, 1, 2, 3, 4, 5, 10, and 20 pounds avoirdupois, and 1 pound troy.
- 1 box containing twenty-four weights,⁹ supplied to States when balances were delivered, as follows: 0.0001, 0.0002, 0.0003, 0.0004, 0.0005, 0.001, 0.002, 0.003, 0.004, 0.005, 0.01, 0.02, 0.03, 0.04, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 1, 2, 4, and 8 ounces avoirdupois.

⁹ The following footnote to the paper of Louis A. Fischer on "History of United States Weights and Measures" delivered in 1905 before the "First Conference on the Weights and Measures of the United States" appears on page 15 of the Report of that Conference: "The denominations of some of the weights were changed in sets supplied after 1857. Instead of decimal parts of the ounce, weights of the following denominations were furnished: $\frac{1}{2}$ ounce, $\frac{1}{4}$ ounce, $\frac{1}{8}$ ounce, and $\frac{1}{16}$ ounce; 50, 25, 10, 5, 4, 3, 2, 1, 0.05, 0.04, 0.03, 0.02, and 0.01 grains."

- 1 box containing twenty-seven weights, 0.0001, 0.0002, 0.0003, 0.0004, 0.0005, 0.001, 0.002, 0.003, 0.004, 0.005, 0.01, 0.02, 0.03, 0.04, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 1, 2, 3, 4, 5, 6, and 10 ounces troy.
- 1 standard yard measure with matrix.
- 1 set of liquid measures, $\frac{1}{2}$ pint, 1 pint, 1 quart, 1 half-gallon, and 1 gallon, each with ground-glass "cover".
- 1 standard $\frac{1}{2}$ -bushel measure, with ground-glass "cover".

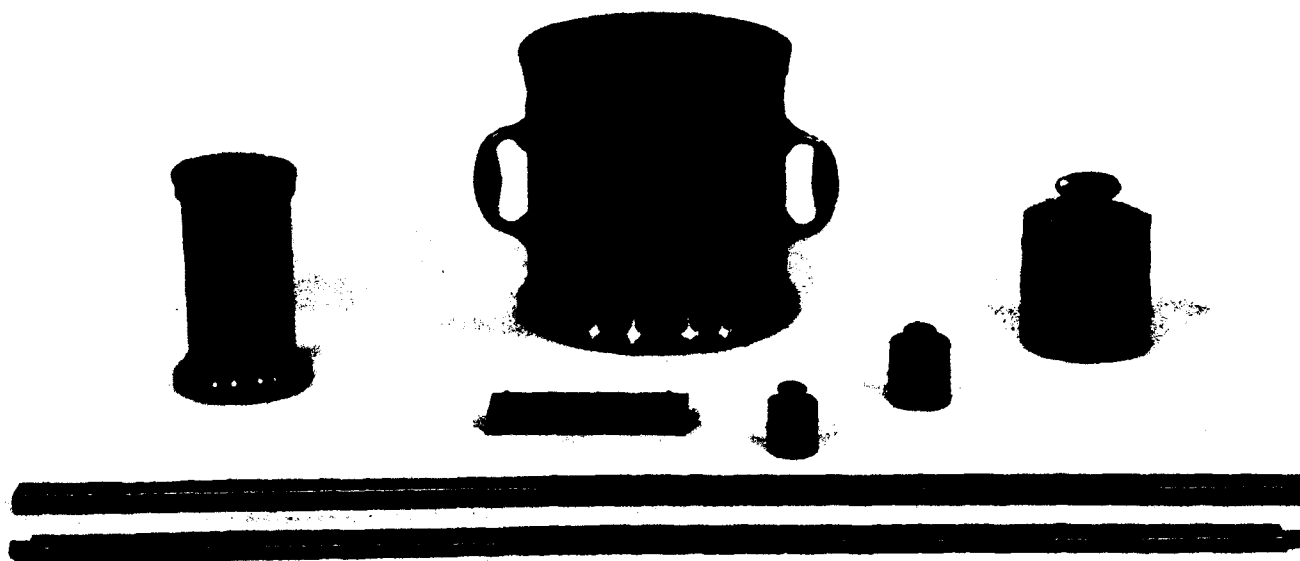
Fisher reports [25] that by the end of 1880 most of the States had received from the Federal Government metric weights and measures as follows:

- 1 brass line meter bar.
- 1 steel end meter bar.
- 1 set of brass capacity measures, 1 liter and 1 dekaliter.
- 1 set of silver weights, 1 milligram to 400 milligrams.
- 1 set of four brass weights, 1 gram, 500 grams, 1 kilogram, 10 kilograms.

The responsibility for the construction of the metric standards for the States fell, quite naturally, upon the Office of Weights and Measures of the Treasury Department, the agency that had prepared the other standards for the States. The French meter and kilogram "of the Archives" were accepted as the fundamental standards. Of several copies of these in the possession of the Office of Weights and Measures, an iron bar known as the "Committee Meter", and a platinum kilogram known as the "Arago Kilogram", were selected as the reference standards to control the construction of the new metric standards.⁹ No physical reference standards of capacity were needed, the new volumetric standards being adjusted on the basis of determinations of the weights of water contained according to the relation, 1 liter equals the volume of 1 kilogram of pure water at the temperature of its maximum density.

A series of events and actions that occurred during the period 1870-1893, although not, strictly speaking, legislation, had a profound and lasting effect upon the weights and measures situation in the United States. These occurrences involved primarily the standards of the metric system of weights and measures. By a combination of adherence to a treaty and administrative action within the Treasury Department, the United States succeeded in correlating its system of weights and measures with those of other nations and in resolving the issue of

⁹ For a description of the Committee Meter and Arago Kilogram, see NBS Miscellaneous Publication No. 64, pp. 16-19.



Standards of length, mass, and capacity of the metric system furnished by the Federal Government to the States under the Joint Resolution of March 3, 1881.

In the immediate foreground is the steel end meter bar and directly behind it is the brass line meter bar. At the left rear are the 1-liter and 1-dekaliter capacity measures. At right center are the 500-gram, 1-kilogram, and 10-kilogram weights. In the small box at the center are the 1-gram and the milligram weights.

its own fundamental standards. A chronology of these events and actions follows:

1870 (August). Representatives from fifteen countries, including the United States, met in Paris at the invitation of the French government, to consider the advisability of constructing new metric standards.¹⁰ Basic standards at that time were the

¹⁰ The essential features of the metric system of weights and measures were crystallized as a result of studies made by the French Academy of Sciences, 1790-1793, and subsequently by the French National Institute of Sciences and Arts. In its original concept (1795) the system was based on a single defined unit—that of length—intended to be reproducible at any time; this unit, to be known as the "meter", was to be one ten-millionth part of a quadrant (one-fourth) of the earth's meridian. Units of capacity and mass were to be derived from the unit of length. Thus the unit to be known as the "liter" was to be the volume of a one-tenth-meter cube, and the unit to be known as the "gram" was to be the mass of a volume of pure water, at the temperature of melting ice, equal to the volume of a one-hundredth-meter cube. Decimal multiples and submultiples of the primary units, with a uniform system of prefix nomenclature, were provided for.

Physical standards—meter and kilogram—were constructed and were legalized in France in 1799; ultimately these were superseded by other similar physical standards. The original theoretical interrelation of units of the system is still closely approximated, but now is neither fixed by definition nor realized in practice, the metric system actually having been based since 1799 on two fundamental physical standards, a particular meter bar and a particular kilogram. The liter is now defined as the volume occupied by one kilogram of pure water at its maximum density and under normal atmospheric pressure, and this volume is slightly larger (by 28 parts in 1,000,000) than one cubic decimeter.

meter and the kilogram "of the Archives", these having been officially adopted in 1799.

1872 (September). Again at the invitation of the French government, representatives from thirty countries, the United States included, met in Paris to pursue the inquiries instituted at the 1870 conference. At these two conferences it was agreed that new meters and kilograms, of uniform material and design and conforming in values with the standards of the Archives, be constructed; that from these, one meter bar and one kilogram be selected to become new international standards; and that the other bars and kilograms be distributed among the participating countries. It was advocated that an international weights and measures bureau be established on neutral ground, preferably near Paris. Also, decisions were reached on numerous technical details dealing with the construction and calibration of the new standards and with related matters.

1875 (March-May). A diplomatic conference was convened in Paris, at which the United States and eighteen other countries were represented, to consider principally the matter of the establishment

of an international bureau of weights and measures. On May 20, 1875, representatives of the United States and sixteen of the other eighteen countries represented signed a treaty (the "Metric Convention"), under the terms of which the International Bureau of Weights and Measures was created and its duties prescribed.

1878 (May 28). The Metric Convention was ratified, upon advice of the Senate, by the President of the United States on May 28, 1878, and was proclaimed September 27, 1878.¹¹ Commenting on this treaty in his "History of the Standard Weights and Measures of the United States" [26], Fisher states:

In addition to the primary work of verifying the new metric standards the bureau [International Bureau of Weights and Measures] was charged with certain duties, the following being the most important:

- (1) The custody and preservation, when completed, of the international prototypes and auxiliary instruments.
- (2) The future periodic comparison of the several national standards with the international prototypes.
- (3) The comparison of metric standards with standards of other countries.

The expenses of the bureau were to be defrayed by contributions of the contracting Governments, the amount for each country depending upon the population and upon the extent that the metric system was in use in the particular country.

In accordance with the terms of the convention the French Government set aside a plot of ground in the park of St. Cloud just outside of Paris (Sèvres), and upon this ground, which was declared neutral territory, the International Bureau of Weights and Measures was established.

1890 (January 2). The copies of the international meter and kilogram having been distributed by lot, the United States was awarded Meters Nos. 21 and 27, and Kilograms Nos. 4 and 20. Meter No. 27 and Kilogram No. 20 were brought from France to the United States, under seal, late in the year 1889, by a representative of the Coast and Geodetic Survey. On January 2, 1890, the two packing boxes were opened at the White House in the presence of President Benjamin Harrison, the Secretary of State, the Secretary of the Treasury, and some twenty-eight other distinguished persons. The contents of the cases were examined and found to be "in good preservation and apparently in every particular in the same state as when first enclosed therein" [27], and accordingly Meter No. 27 and Kilogram No. 20 were accepted as authentic by President Harrison.

¹¹ This treaty was amended by the convention signed at Sevres, France, October 6, 1921; ratified by the President of the United States September 19, 1923; proclaimed October 27, 1923. For a translation of the amended text of the convention and of the regulation appended thereto, see NBS Circular 501, "Federal and State Weights and Measures Laws", pages 3-5.

These standards were then placed in the custody of the Office of Weights and Measures¹² of the Treasury Department.

1890 (July). Meter No. 21 and Kilogram No. 4 were received in Washington and were deposited in the Office of Weights and Measures.¹³

1893 (April 5). The Secretary of the Treasury approved a ruling of fundamental importance, made by T. C. Mendenhall, Superintendent of Standard Weights and Measures, and published by the Coast and Geodetic Survey of the Treasury Department as "Bulletin No. 26, Fundamental Standards of Length and Mass, Approved for Publication April 5, 1893." The following quotation from Bulletin No. 26, which has come to be known as the "Mendenhall Order", expresses the essential part of the ruling:

* * * the Office of Weights and Measures, with the approval of the Secretary of the Treasury, will in the future, regard the International Prototype Metre and Kilogramme as fundamental standards, and the customary units, the yard and the pound, will be derived therefrom in accordance with the Act of July 28, 1866. * * *

Bulletin No. 26 also carried a "Note", as follows:

Note.—Reference to the Act of 1866, results in the establishment of the following:

Equations

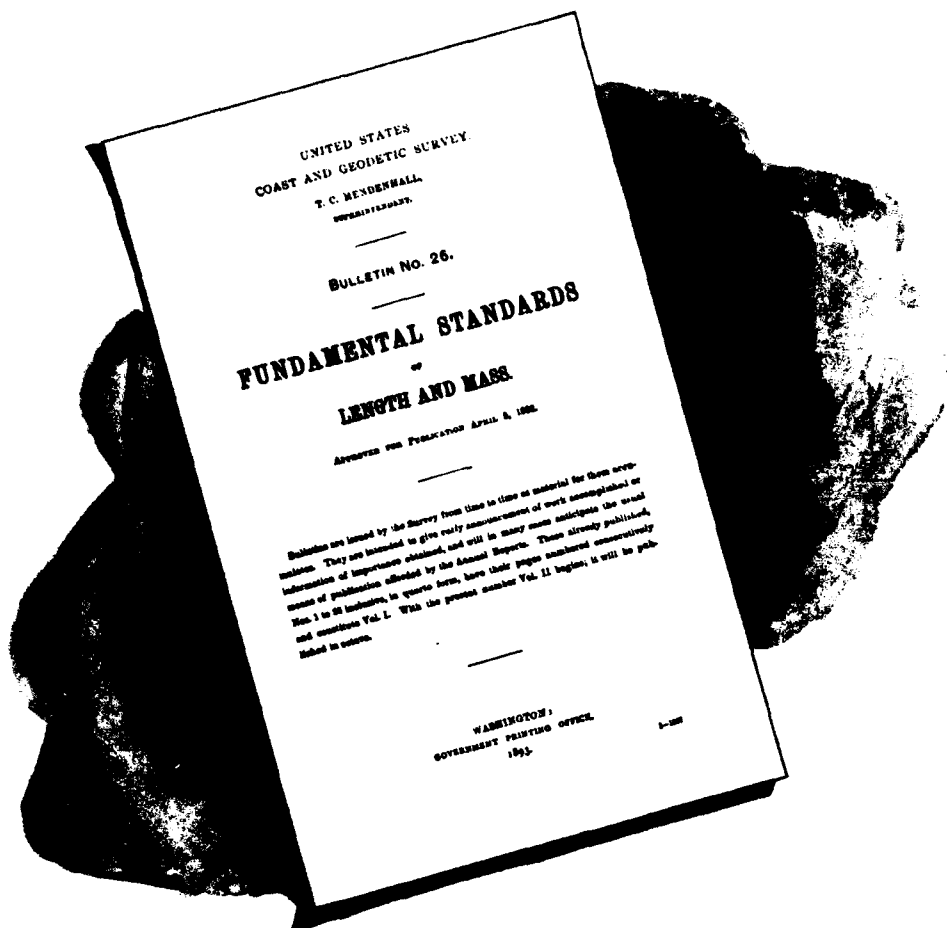
$$1 \text{ yard} = \frac{3600}{3937} \text{ metre.}$$

$$1 \text{ pound avoirdupois} = \frac{1}{2.2046} \text{ kilo.}$$

A more precise value of the English pound avoirdupois is $\frac{1}{2.20462}$ kilo., differing from the above by about one part in one hundred thousand, but the equation established by law is sufficiently accurate for all ordinary conversions.

¹² This organizational unit, during the course of its existence, was variously known as the Office of Weights and Measures and the Office of Standard Weights and Measures. It ceased to exist under the terms of a Federal Act of March 3, 1901, which provided that "The Office of Standard Weights and Measures shall be known as the National Bureau of Standards." The National Bureau of Standards was in the Treasury Department until the creation of the Department of Commerce and Labor by the Act of February 14, 1903, when it was transferred to that Department. By the Act of March 4, 1913, the Department of Commerce and Labor was divided into the Department of Commerce and the Department of Labor, and the National Bureau of Standards was assigned to the Department of Commerce, where it has since remained.

¹³ These meter bars and kilograms (Meters Nos. 21 and 27 and Kilograms Nos. 4 and 20) are composed of an alloy of 90 percent platinum and 10 percent iridium. The meter bars are line standards, with a modified X cross section, 20 millimeters in over-all height and width, and with a median plane or neutral axis lying exactly in the center of the bar; the defining lines are on the median surface, each defining line being flanked on either side by a guide line. The kilograms are cylinders of equal diameter and height—approximately 39 millimeters—having slightly rounded edges. Custody of Meters Nos. 21 and 27 and Kilograms Nos. 4 and 20 and of other standards and property of the Office of Weights and Measures was transferred to the National Bureau of Standards when the latter was created by the terms of the Act of March 3, 1901.



The cover page of Coast and Geodetic Survey Bulletin No. 26, in which the "Mendenhall Order" was published.

With the publication of this ruling as of April 5, 1893, the international meter and kilogram were officially recognized as the fundamental standards of length and mass of the United States.

As already stated, in work of high precision the kilogramme is now all but universally used and no conversion is required.¹⁴

To complete the account of attempted congressional enactments in the area of weights and measures in the 1836-1896 era, it is necessary to revert to its halfway point, 1866, when the metric law was enacted. From then until the end of the era, 1896, that is, during the 40th to the 54th Congresses, inclusive, the most consistent effort revolved around the metric system of weights and measures. It is found that no less than 13 such bills and one resolution were introduced in the House and one bill in

¹⁴ The National Bureau of Standards continues to consider the relation

$$1 \text{ yard} = \frac{3600}{3937} \text{ meter,}$$

which also may be expressed

$$1 \text{ meter} = 39.37 \text{ inches,}$$

as an exact equivalent. In the case, however, of the relation between the avoirdupois pound and the kilogram, the National Bureau of Standards now recognizes as the fundamental relation

$$1 \text{ avoirdupois pound} = 0.453 \, 592 \, 427 \, 7 \text{ kilogram,}$$

which corresponds with

$$1 \text{ kilogram} = 2.204 \, 622 \, 341 \text{ avoirdupois pounds.}$$

(See NBS Circular 570, "Units and Systems of Weights and Measures".)

the Senate; the resolution in question (providing for a commission to report on a decimal system) passed the House on the day of its introduction, but this was the only adoptive action on any of this proposed legislation. Ten of the bills provided for the adoption of the metric system, four for the country as a whole, two for the departments of the Federal Government, and four for the customs service. Four of the bills were designed to facilitate use of the metric system.

In the area of miscellaneous weights and measures matters, other than the metric system, only two House bills and two House resolutions need be mentioned. A bill in 1867 dealt with the sealing of weights and balances used by national banks, navy yards, and customhouses; the two resolutions (1876 and 1877) proposed an international convention to establish a uniform system of weights and measures throughout the world; and the second bill (1892) proposed a uniform standard for grains. None of these proposals was enacted.

The 1836-1896 era may be considered essentially to have concluded insofar as meaningful action is concerned, with the publication of the Mendenhall Order. The discussion of this era should not be

terminated, however, without brief comment on the character of the Mendenhall Order itself, and of its similarity, in one important aspect, to the orders issued by the Treasury Department attendant upon the construction of standards for the customhouses.

It has already been reported¹⁵ that following the investigation of weights and measures standards in use at the customhouses as directed by the Senate Resolution of May 29, 1830, during which numerous discrepancies were found, the Secretary of the Treasury, Louis McLane, told the Senate that he believed that his Department had "full authority to correct this evil, by causing uniform and accurate weights and measures, and authentic standards, to be supplied to all customhouses"; that Hassler was instructed to undertake the construction of the necessary weights and measures for this purpose; and that, upon Hassler's recommendation, certain standard units were adopted by the Treasury Department as the basis for the construction of the weights and measures in question. This was action by administrative decision, without specific congressional directive or authorization; however, this action later on received indirect, but not specific, approval by the Congress with the adoption of the Joint Resolution of June 14, 1836.

This first (and very important) decisive action toward fixing standards of weight and measure for the United States having thus been initiated by the Treasury Department, there is found in the Mendenhall Order a second instance of a fundamental weights and measures action being taken—some sixty years later—as a result of administrative decision within the Treasury Department. It may also be noted that since 1893, when the Mendenhall Order was promulgated, whereas the original equation for the yard-meter relation has continued to be recognized, the original equation for the pound-kilogram relation has been modified—again by administrative action.

The Ingham-McLane orders led directly to uniformity among the States in their weights and measures standards and their agreement with standards of the Federal Government. The Mendenhall Order brought about conformity between the Federal standards and the standards of other nations. Thus, in the area of metrological units and standards, the uniformity, agreement, and conformity just mentioned have been achieved by the forthright admin-

istrative acts of certain executive officers of the Federal Government. The essence of the Mendenhall Order, that is, to "regard the International Prototype Metre and Kilogramme as fundamental standards" of the United States, has been observed for the past sixty-odd years.

Résumé of the Mendenhall Era, 1836-1896.—What has been termed herein the "Mendenhall Era", might also be characterized as the "Metric Era", because of the emphasis on the metric system and standards of the metric system, which began with the Act of 1866 and culminated in the approval of the Mendenhall Order in 1893.

During the first two decades of the era, the initial distribution to the States of standards of weight and measure was essentially completed by the new Office of Weights and Measures, set up originally under Hassler's direction in the Treasury Department. That same Office carried out the construction and the distribution to the States of balances, as provided by the Act of July 7, 1838. The Act of July 28, 1866, legalized the use in the United States of weights and measures of the metric system, and a Joint Resolution of July 27, 1866, directed that the States be furnished standards of metric weight and measure. Agricultural colleges of the States were furnished standard weights and measures under terms of the Joint Resolution of March 3, 1881.

Adherence to the Metric Convention by the United States was accomplished in 1878 when the ratification of this treaty was proclaimed on September 27 of that year. The copies of the international meter and kilogram allotted to the United States under the terms of the treaty having been received in this country, these were turned over to the Office of Weights and Measures in 1890. On April 5, 1893, the far-reaching "Mendenhall Order" was approved by the Treasury Department; under this order the international meter and kilogram became the "fundamental" standards of length and mass for the United States. During the latter part of this era, numerous unsuccessful efforts were made to enact Federal legislation for general or limited adoption of the metric system of weights and measures.

The outstanding accomplishment of this era was undoubtedly the action by the Treasury Department that made possible the correlation of the United States standards of weight and measure with those of other countries through the medium of the international metric standards.

¹⁵ See p. 8.

The Modern Era, 1896-1956

The final sixty-year period covered by this discussion may be considered as the modern era. It is characterized by much consideration and no little action by the Congress on a variety of weights and measures subjects. So many bills, in fact, have been introduced that for purposes of this discussion it has been found expedient to group many of these into categories, reporting upon categories rather than upon individual bills. Furthermore, it is believed that it will be most helpful to the reader if, in general, the unsuccessful efforts are first reported upon as a group, this treatment being followed by a somewhat more detailed report dealing with enacted statutes.

The attention given by the Congress to the metric system of weights and measures during the latter half of the preceding era has already been noted. During the four succeeding decades—specifically, between 1897 and 1933—it is found that bills and resolutions relating to the metric system or to some "decimal" system totaled at least thirty-six, twenty-three in the House and thirteen in the Senate. Of these, thirteen House bills, seven Senate bills, and one Senate Joint Resolution were directed to the adoption of the metric system, although three of the bills were of limited application; eight House bills (two of limited application) and five Senate bills were directed to the adoption of a "decimal" system of weights and measures. The two remaining measures (House Joint Resolutions) were related to the metric or a decimal system. None of these was enacted. The distribution of these measures within the era is of interest: Nine measures were introduced during the first decade, two during the second decade, twenty-three during the third decade, and two during the fourth decade.

With respect to proposed Federal weights and measures legislation on subjects other than the metric system or some other decimal system of weights and measures, seventy-three House bills and four House resolutions, and thirty-five Senate bills and one Senate resolution, for a total of one hundred thirteen measures, have been located as having been introduced during the 1896-1956 era and as having failed of enactment. The problems of achieving enactment of bills in the field of weights and measures are both considerable and complex. Resolution of technical difficulties with due regard to contemporary public opinion has always been an obstacle to achieving substantive agreement. Without any attempt to discriminate closely with

respect to their provisions, these unsuccessful measures have been separated into general subject-matter categories and grouped chronologically by decades. (See table p. 20).

With respect to these tabulated unsuccessful measures, later enactments of the Congress provided for coverage of the objectives of some of these bills.

It may be noted that among the measures reported in the preceding tabulation are three House bills and two Senate bills that represent two distinct efforts by the National Bureau of Standards to improve the legal status of the United States units and standards of weight and measure. These bills are those characterized in the tabulation as "To define units and fix standards of weight and measure for U. S.", listed in the fifth and sixth decades. In 1937 the Bureau was successful in causing the introduction of bills in House and Senate designed to define certain basic units and legalize certain standards by specific congressional action. With only minor modification these bills were again introduced in 1938. Nine years later, in 1947, the effort was renewed with the introduction of a House bill similar to the 1937 and 1938 bills and having the same objective.

So much for the efforts that did not result in legislation during this period. With respect to the Federal weights and measures enactments of the 1896-1956 era, the first four decades of the period are found to have been the most fruitful, having produced the large majority of the statutes with which weights and measures officers of today are concerned or in which they are interested. In the discussion that follows, these enactments will be treated chronologically, but a number of acts of secondary interest have been excluded from consideration even though they may be said to fall in the broad category of "weights and measures." Following the comment on each current statute, a citation is given to its location in the 1952 edition of the United States Code.

1901. The Act of March 3, 1901, created the National Bureau of Standards as the successor to the Office of Standard Weights and Measures of the Treasury Department, but with greatly enlarged functions. The original "organic act" of the Bureau was amended in 1913, 1930, 1932, and 1950 as need arose for changing or broadening the operations of the Bureau. Originally assigned to the Treasury Department, the National Bureau of Standards was transferred to the new Department of Commerce and Labor in 1903. Ten years later, "Commerce and

MISCELLANEOUS MEASURES INTRODUCED INTO CONGRESS 1897-1956 BUT NOT ENACTED

Decade	General character of measures	
	House ^a	Senate ^a
1897 to 1906, incl.	To furnish standards to States for use by colleges (1). To investigate the subject of weights and measures (1). Re foods and drugs in the District of Columbia and Territories (3).	Re foods and drugs in the District of Columbia and Territories ^b (1).
1907 to 1916, incl.	Re standards of weight for various commodities (1). To investigate the subject of weights and measures (2). Re Federal pattern approval for commercial devices (2). Re units of weight and measure (3). Re uniform system of weights and measures (3). Re use of fraudulent devices in commercial transactions (4).	Re Federal pattern approval for commercial devices (1). Re standard barrel for fruits, vegetables, and dry commodities (1).
1917 to 1926, incl.	To amend Food and Drugs Act of 1906 (1). Re uniform system of weights and measures (2). To license certain weighers and inspectors (2). Re standard weights for bread and other commodities (3). Re standard packages for flours, meals, and feeds (4). Re Federal pattern approval for commercial devices (6).	Re standard commodity units in merchandising (1). Re standard weights for bread loaves (1). Re standard containers for fruits and vegetables (1).
1927 to 1936, incl.	Re standard containers for fruits and vegetables (1). To establish commodity quantity units (1). To amend Lime Barrel Act (1). Re Federal pattern approval for commercial devices (2). Re foods, drugs, and cosmetics (5). Re net weight for cotton bales (5). To amend Food and Drugs Act of 1906 (9).	To amend Lime Barrel Act (1). To consolidate Federal standard container acts (1). To amend Standard Container Act of 1916 (2). Re foods, drugs, and cosmetics (3). To amend Food and Drugs Act of 1906 (16).
1937 to 1946, ^c incl.	To standardize food packages (1). To consolidate Federal Standard Container Acts (1). To standardize can sizes (1). Re Federal pattern approval for commercial devices (1). To amend Food and Drugs Act of 1906 (2). To define units and fix standards of weight and measure for U. S. (2). Re net weight for cotton bales (2). Re foods, drugs, and cosmetics (3).	Re net weight for cotton bales (1). To define units and fix standards of weight and measure for U. S. (2).
1947 to 1956, incl.	To define units of weight and measure (1). Re packages of food subject to shrinkage (1).	To amend Standard Container Act of 1928 ^d (1). To amend Food, Drug, and Cosmetic Act (2).

^a Number of measures is shown in parenthesis.

^b The "Food and Drugs Act of 1906" was enacted as a result of a different bill.

^c The "Food, Drug, and Cosmetic Act" was enacted in this decade.

^d A companion House bill was enacted.

Labor" was divided into "Commerce" and "Labor", and the National Bureau of Standards was assigned to the Department of Commerce, where it has since remained. The principal functions of the National Bureau of Standards with respect to weights and measures administration may be summarized by saying that the Bureau has the custody of the national standards of weight and measure, that it tests the reference standards of the States, and that through its Office of Weights and Measures it cooperates closely with State and local weights and measures officials by supplying technical information, advice on practical problems of administration, and

training of personnel. These activities are not of a "regulatory" character, the Bureau having no enforcement power or authority. [U. S. Code, 1952 Ed., Title 15, Ch. 7.]

1906. The "Food and Drugs Act of June 30, 1906" was enacted, containing among many others, provisions relative to content declarations on packages of foods. This act was the culmination of a long effort to enact legislation to require purity in foods and drugs; it is said that "in the 27 years between 1879 and 1906, over 190 measures relating to the control of the adulteration and misbranding of foods and drugs were introduced in the Congress

of the United States" [28]. In its original form, the labeling of packages of food with declarations of net quantity was not mandatory; "if in package form and the contents are stated in terms of weight or measure", then such statement was required to be correct. In 1913 the act was amended (the so-called "Gould net-weight amendment") to require that all foods in package form bear net-content declarations in terms of weight, measure, or numerical count, but with the proviso that "reasonable variations shall be permitted, and tolerances and also exemptions as to small packages shall be established by rules and regulations." The Kenyon wrapped meat amendment" was adopted in 1919; under this, wrapped meats were declared to be "in package form" for purposes of the act. The enforcement of the act was in the Department of Agriculture, first in the Bureau of Chemistry, later in the Food, Drug, and Insecticide Administration, and finally in the Food and Drug Administration. (This act has largely been superseded by the Food, Drug, and Cosmetic Act of 1938.)

1911. The standard for the regulation of the coinage of the United States was changed from the "troy pound of the Mint" to the "standard troy pound of the Bureau of Standards of the United States" by the act of March 4, 1911. [U. S. Code, 1952 Ed., Title 31, Ch. 8.]

1912. The act of August 3, 1912, known as the "Standard Apple-Barrel Act", established by dimension and capacity a standard apple barrel of 7056 cubic inches, and standard grades, for apples shipped in interstate commerce. (The standard-barrel provisions of this act were superseded by the "Standard Barrel Act of March 4, 1915.")

1914. The Federal Trade Commission was created in 1914, and since then the act has been amended from time to time. Under the law, "unfair methods of competition in commerce, and unfair and deceptive acts or practices in commerce, are declared unlawful." Some elements of the activities of the Commission lie in the general "weights and measures" area. [U. S. Code, 1952 Ed., Title 15, Ch. 2.]

1915. The "Standard Barrel Act of March 4, 1915" fixed, by dimension and capacity, a standard barrel for "fruits and vegetables and other dry commodities other than cranberries", this being the same barrel as had been fixed for apples in 1912 (7056 cubic inches), and fixed, by dimension, a standard barrel for cranberries having a capacity some 1230 cubic inches smaller. Subdivisions of $\frac{3}{4}$

barrel, $\frac{1}{2}$ barrel, and $\frac{1}{4}$ barrel were provided for in each case. This law applies in the case of both intrastate and interstate transactions, and specifically provides that prosecutions for violations may be begun upon complaint of State and local weights and measures officials. [U. S. Code, 1952 Ed., Title 15, Ch. 6.]

1916. The "Standard Lime Barrel Act of August 23, 1916" established a "large" barrel of 280 pounds net weight and a "small" barrel of 180 pounds net weight for importations and interstate shipments of lime, and also recognized transactions in fractional parts of the small barrel. Net-content declarations are required on barrels or other containers. [U. S. Code, 1952 Ed., Title 15, Ch. 6.]

Also enacted in this year was the "Standard Container Act of 1916", approved on August 31, 1916, and amended (with respect to mushroom baskets) on June 11, 1934. The act is enforced by the Department of Agriculture. It fixes the standards for Climax baskets for "grapes and other fruits and vegetables" and for mushrooms as baskets of 2, 4, and 12 quarts dry measure, and specifies the dimensions to be followed in the manufacture of the boxes. Provision is also made for a 1-pound Climax basket of specified dimensions for mushrooms only. Baskets or other containers for "small fruits, berries, and vegetables" are required to be $\frac{1}{2}$ pint, 1 pint, 1 quart, and multiples of the quart, dry measure. This act applies to interstate transactions only. [U. S. Code, 1952 Ed., Title 15, Ch. 6.]

1921. The "Packers and Stockyards Act of August 15, 1921", subsequently amended several times, gives the Department of Agriculture considerable authority over weighing facilities and practices at stockyards that exceed a specified size, and at designated live-poultry markets. [U. S. Code, 1952 Ed., Title 7, Ch. 9.]

1928. The "Standard Container Act of 1928", approved May 21, 1928, supplements the Standard Container Act of 1916 by extending controls to hampers, round stave baskets, and splint baskets. This act is intrastate as well as interstate in application, and is enforced by the Department of Agriculture. Standard hampers and round stave baskets for fruits and vegetables were originally fixed as $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, and 2 bushels; in 1954 the act was amended to add the $\frac{3}{8}$ -bushel size. Splint baskets for fruits and vegetables are fixed as 4, 8, 12, 16, 24, and 32 quarts, standard dry measure. Manufacturers' specifications for baskets

covered by the act are required to be approved by the Secretary of Agriculture. The act does not apply to Climax baskets, berry boxes, and till baskets that comply with the provisions of the Standard Container Act of 1916. [U. S. Code, 1952 Ed., Title 15, Ch. 6.]

1935. The "Tobacco Inspection Act", enacted in 1935 and enforced by the Department of Agriculture, contains certain provisions dealing with weighers and inspectors of tobacco. [U. S. Code, 1952 Ed., Title 7, Ch. 21A.]

Also enacted in 1935, and subsequently amended, the "Federal Alcohol Administration Act", enforced by the Treasury Department, contains provisions relative to the packaging, labeling, and net contents of bottled distilled spirits, wine, and malt beverages. [U. S. Code, 1952 Ed., Title 27, Ch. 8.]

1938. The "Federal Food, Drug, and Cosmetic Act of June 25, 1938" supersedes, with specified exceptions relative to butter and wrapped meats, the Food and Drugs Act of 1906. It is administered by the Food and Drug Administration, an agency that was in the Department of Agriculture until June 30, 1940 when it was transferred to the Federal Security Agency; it remained there until April 11, 1953, when it was assigned to the newly created Department of Health, Education, and Welfare, where it has since remained. The act declares, among other provisions, that a food, drug, device, or cosmetic shall be deemed to be misbranded (a) if its labeling is false or misleading in any particular, (b) if in package form unless it bears a label containing an accurate statement of the quantity in terms of weight, measure, or numerical count, and (c) in the case of food if its container is so made, formed, or filled as to be misleading. Provision is made for reasonable variations and for exemptions as to small packages. [U. S. Code, 1952 Ed., Title 21, Ch. 9.]

1939. In the "Internal Revenue Code" enacted in 1939 (some of the sections of which trace their origins to provisions of much earlier revenue laws) references are found to proof gallons, to barrels for fermented liquor, and to false weights and measures in connection with substances to be used for distillation. [U. S. Code, 1952 Ed., Title 26, Ch. 26, Subchapters A and D.]

1946. The "Agricultural Marketing Act of 1946" contains provisions relative to the packaging of agricultural commodities, and is administered by the Department of Agriculture. [U. S. Code, 1952 Ed., Title 7, Ch. 38.]

1947. The "Federal Insecticide, Fungicide, and Rodenticide Act", enacted in 1947 and enforced by

the Department of Agriculture, contains requirements for the labeling of "economic poisons" with statements of net weight or measure. [U. S. Code, 1952 Ed., Title 7, Ch. 6.]

Finally, in the current statutory schedule of duties on imports, bushel weights are specified for barley, corn, oats, rye, wheat, apples, and flaxseed, there is reference to a pineapple crate of 2.45 cubic feet, and the "line" as a button measure is defined as $\frac{1}{40}$ inch. [U. S. Code, 1952 Ed., Title 19, Ch. 4, Schedules 7 and 15.]

Résumé of the Modern Era, 1896-1956.—Interest in the metric system of weights and measures or in some decimal system of weights and measures carried over from the preceding era and persisted for about thirty-five years, during which many bills on this general subject were presented to the Congress; none was enacted. Equally unsuccessful were several bills introduced late in the era, designed to improve the legal status of accepted units and standards. Concentrated largely in the four middle decades of the era, more than one hundred other bills on miscellaneous weights and measures subjects were introduced into the Congress but not enacted; some of these sought merely to amend existing statutes, and a number of them were the forerunners of subsequent legislation.

The total of the Federal statutes having weights and measures significance that were enacted during the modern era is, however, impressive. The more important of these are tabulated, with the year of enactment shown in each case:

1901. The act creating the National Bureau of Standards.

1906. The Federal Food and Drugs Act. This was amended in 1913 and in 1919.

1911. The Act substituting the standard troy pound of the Bureau of Standards for the troy pound of the Mint as the standard for the regulation of the coinage.

1912. The Federal Standard Apple Barrel Act.

1914. The act creating the Federal Trade Commission.

1915. The Federal Standard Barrel Act.

1916. The Federal Standard Lime Barrel Act.

1916. The Federal "Standard Container Act of 1916".

1921. The Federal Packers and Stockyards Act.

1928. The Federal "Standard Container Act of 1928".

1938. The Federal Food, Drug, and Cosmetic Act.

References

- [1] In the preparation of this Circular, free use has been made of the information contained in NBS Miscellaneous Publication 64, "History of the Standard Weights and Measures of the United States," by Louis A. Fischer, NBS Miscellaneous Publication 122, "Weights and Measures in Congress", by Sarah Ann Jones, and the Introduction to NBS Circular 501, "Federal and State Weights and Measures Laws". These publications are available for consultation in Government Depository Libraries.
In addition to the "Journals" of the House and Senate and copies of Bills and Resolutions introduced into the Congress, an important source of information has been Volume II of "American State Papers—Class X Miscellaneous". These published "Papers" are subtitled "Documents, Legislative and Executive, of the Congress of the United States—Selected and Edited, under the authority of Congress by Walter Lowrie, Secretary of the Senate, and Walter S. Franklin, Clerk of the House of Representatives", and were published in Washington in 1834 by Gales and Seaton. Volumes I and II of the "Papers" cover the period from the 1st Session of the 1st Congress, March 3, 1789, through the 2d Session of the 17th Congress, March 3, 1823.
- [2] American State Papers, Class X, Miscellaneous, v. II, p 730.
- [3] *Ibid.*, p 736.
- [4] *Ibid.*, p 736.
- [5] Annals of Congress, v. 1 (1834) col. 932-33, Senate, Jan. 8, 1790.
- [6] Report of the Secretary of State [Thomas Jefferson] on the subject of establishing a uniformity in the Weights, Measures and Coins of the United States, 1790, pp 18, 22, 29, 30, 36, 37.
- [7] *Ibid.*, p 39.
- [8] Annals of Congress, v. 2 (1834) col. 1730, Senate, Dec. 8, 1790.
- [9] *Ibid.*, col. 1772, Senate, Mar. 1, 1791.
- [10] *Ibid.*, v. 3 (1849) col. 14-15, Senate, Oct. 25, 1791.
- [11] American State Papers, Class X, Miscellaneous, v. II, p 656.
- [12] It appears that this report was originally printed, as ordered, by Abraham Small, Philadelphia, in 1821, under the title "Report upon Weights and Measures, by John Quincy Adams, Secretary of State of the United States". The text of the report was reprinted as No. 503 in Vol. II, Class X, of "American State Papers", published under the authority of Congress by Gales and Seaton, Washington, in 1834. Only a comparatively few copies of the report in either of these forms are known to be in existence today.
- [13] American State Papers, Class X, Miscellaneous, v. II, p 704.
- [14] *Ibid.*, p 691.
- [15] *Ibid.*, p 542.
- [16] *Ibid.*, pp 927-28.
- [17] Statutes at Large, v. IV, p 277.
- [18] NBS Miscellaneous Publication M122, p 14 (1936).
- [19] *Ibid.*
- [20] NBS Miscellaneous Publication No. 64, pp 7-10, 12-14 (1925).
- [21] Register of Debates, v. 12 (4) (1836) Appendix, p XIX.
- [22] Public 53, 25th Congress, 2d Session. The original purpose of this act was "to provide for the support of the Military Academy of the United States for the year 1838."
- [23] NBS Circular 501, p 2 (1951).
- [24] *Ibid.*
- [25] NBS Miscellaneous Publication No. 64, p 19 (1925).
- [26] *Ibid.*, pp 20-21.
- [27] From the certificate in relation to the receipt of the standards, signed by President Harrison. See reproduction of certificate, NBS Miscellaneous Publication No. 64, p 25 (1925).
- [28] "Food Regulation and Compliance", by Arthur D. Herrick, Vol. I, p 8.